CS230 EMC (Voting and Social Choice) Assignment

Assignment Due LDoC 04/24

1 Gradescope Assignment

This assignment essentially asks you to simulate all voting mechanisms we covered in class on the data you all generated in class. It has seven parts (corresponding to six voting mechanisms and the pairwise election graph of the four seasons, **as well as a bonus question that can make up for at most three missing parts**. The idea is really anyone who shows up and learns these voting mechanisms will only need to submit this assignment once.

Here are the results of the season poll in class:

Ranked 1st	Ranked 2nd	Ranked 3rd	Ranked 4th	# of votes
Spring	Summer	Fall	Winter	4
Spring	Summer	Winter	Fall	5
Spring	Fall	Summer	Winter	8
Spring	Fall	Winter	Summer	1
Spring	Winter	Summer	Fall	0
Spring	Winter	Fall	Summer	0
Summer	Spring	Fall	Winter	5
Summer	Spring	Winter	Fall	4
Summer	Fall	Spring	Winter	6
Summer	Fall	Winter	Spring	2
Summer	Winter	Spring	Fall	0
Summer	Winter	Fall	Spring	2
Fall	Spring	Summer	Winter	4
Fall	Spring	Winter	Summer	4
Fall	Summer	Spring	Winter	6
Fall	Summer	Winter	Spring	2
Fall	Winter	Spring	Summer	4
Fall	Winter	Summer	Spring	4
Winter	Spring	Summer	Fall	1
Winter	Spring	Fall	Summer	1
Winter	Summer	Spring	Fall	1
Winter	Summer	Fall	Spring	0
Winter	Fall	Spring	Summer	2
Winter	Fall	Summer	Spring	0

Table 1: Table of votes from $N = 66$ students in class

For all parts in this assignment, if there is a tie, please clearly state that there is a tie and specify the entire set of candidates that make the tie. Afterwards, if tie-breaking is necessary for you to proceed, break ties by Spring $\succ$ Summer $\succ$ Fall $\succ$ Winter (i.e., whenever there is a tie, the season that happens first wins).

1. (Scoring rules)
   (a) What is the plurality score for all four seasons, and which one is the winner?
   Sanity check. *The scores should add up to* $N = 66$.
   (b) What is the veto (anti-plurality) score for all four seasons, and which one is the winner?
   Sanity check. *The scores should add up to* $3N = 198$.
   (c) What is the Borda score for all four seasons, and which one is the winner?
   For this part, use the convention that the season ranked first gets 3 points, the season ranked second gets 2 points, and so on (so the season ranked last gets no points).
   Sanity check. *The scores should add up to* $(3 + 2 + 1)N = 396$. *One of them is* 111.

2. (Pairwise Elections-Based Rules)

   (a) What is the pairwise election graph for our data? Please make sure every edge (there should be six) is directed with an integer weight (the gap/margin of each pairwise election).
   Note: I already did the edge weights for Spring for you so that you can sanity check against them. The rest are your job. You may attach a hand-drawn figure. Alternatively, you may directly edit the LaTeX code for the figure below (please follow the instructions in the comments to reverse the edge directions).

   Sanity check. *As N is even, all edge weights should be even. Why?*

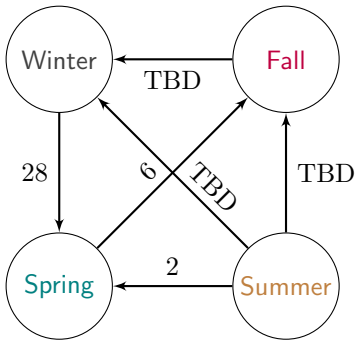

Figure 1

   (b) What is the Copeland score for all four seasons, and which one is the winner?
   Sanity check. *The scores should add up to* 12.

   (c) What is the Simpson score (the weight of the "worst loss" for all four seasons), and which one is the winner?
   If a season never loses, the score is 0 *and that season wins.*

3. (Single Transferable Vote) What happens when we apply the Single Transferable Vote rule to our data? Please clearly specify the order in which the non-winning seasons get eliminated.
   You do not need to specify the plurality scores for each round.
   Hint. The first round is already done in 1(a), and the last round is a pairwise election already done in 2(a).

4. (**Bonus:** Limitations)

   Towards the end of the class, we discussed one fundamental limitation of the social choice model: it assumes people would vote truthfully instead of strategically. What are some other issues around voting/elections/collective decision-making in the real world that are *completely not captured* by our social choice model but quite relevant to electing good candidates/making good decisions? Please elaborate.
   For each issue, briefly describe why our mathematical model does not account for the issue, as well as a potential modification to the model to take the issue into account. You may discuss at most three issues. Each additional valid issue that you discuss can compensate for an N in the previous parts.